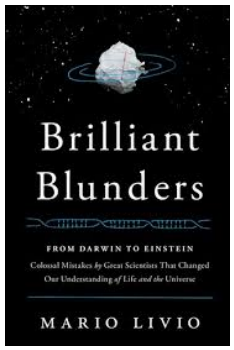
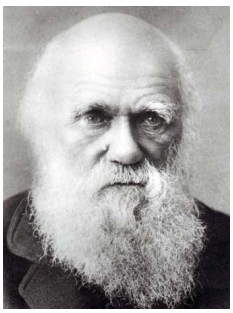
Brilliant Blunders: From Darwin to Einstein. Colossal mistakes by great scientists that changed our understanding of Life and the universe by *Mario Livio*. Simon & Schuster, 2013, ISBN 978-0-14-3919-236-8 (hbk), 352 pp.

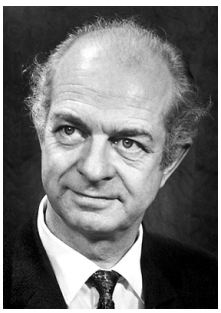


Mario Livio

Great scientists who developed brilliant revolutionary theories have gained an almost super-human status. However as Mario Livio so meticulously describes in this book, such theories are not born perfect and polished and even the greatest scientists erred brilliantly. His story is braided around five scientists and their blunders, but it also gives a detailed historical description of how science evolved. Indeed, human knowledge is a dynamical, ever changing system that builds on existing structures, but that needs a mutation or crossover from time to time. The Big Five of this book are the ones that colored outside the box. Livio selected Charles Darwin, Linus Pauling, Lord Kelvin, Albert Einstein and Fred Hoyle. One would expect they cover quite different fields, but Livio molds them into a continuous account.

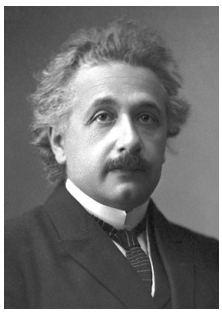


Darwin



Pauling

Kelvin



Einstein

Hoyle

Darwin's blunder was blending inheritance: children have the blended genes of their parents, which undermined his own theory of evolution. Of course he was not aware of the genetics research and the structure of DNA that Pauling was trying to discovered. That came much later. However Pauling wrongly proposed a triple helix structure for DNA and he was beaten by Francis Crick and James Watson who finally got it right. Darwin's theory would need the Earth to have existed for a very long time and Kelvin wanted to rebut this on an energetic basis. After doing the math he found that the Earth must be some 100 million years old while it is actually 4.567 billion years. Kelvin missed the fact that the Earth is not a solid rock with heat transfer by conduction but that there was also heat transfer by convection as volcanic eruptions testify. Looking beyond the Earth at the dynamics of the universe, Hoyle proposed the steady-state universe. George Lemaître countered this with his Big-Bang theory, which was confirmed by the observation of the background radiation. It is often stated that Einstein considered adding an artificial cosmological constant to his equations to be his biggest blunder. However Livio carefully examines the evidence and concludes that Einstein never said that but that George Gamov is the originator of that rumour. However Einstein afterwards removed dark matter from his theory and that turned out to be a blunder because fifty years after his death it was found that actually 75% of the total mass of the universe is dark energy.

Livio succeeds in taking the lay reader along in this fascinating evolution of science in the 19th and 20th century. We get some insight in how new theories develop, and we learn something about the psychology of the scientists paving the road. How they competed with each other, sometimes gracefully admitting that they made an error, sometimes stubbornly clinging to their own theory against all evidence.

There is no mathematics in this book. First of all because Livio wants to bring the story to a broad audience, and secondly, although some of the theories were based on thorough calculations and these are not essential to the message he wants to bring. So why to bring this review to the attention of the readers of this Newsletter who are assumed to be mathematicians? First, it is interesting to learn the dynamics of scientific knowledge, and mathematics is an essential part of science as such. But math is

also an important instrument in other scientific disciplines and becoming even more so every day.

My main reason is however a nice whodunit story that Livio inserts concerning George Lemaître. Lemaître, was a Belgian priest with a doctoral degree in math from the Leuven University in 1920 as a student of de la Valée Poussin[1] for his research on multivariate functions. Arthur Eddington from Cambridge introduced him to cosmology, whereupon he moved to Harvard to work with Harlow Shapley and got another PhD at MIT in 1927. In that year he published in the *Annales de la Société Scientifique de Bruxelles* a paper entitled '*Un Univers homogène de masse constante et de rayon croissant rendant compte de la vitesse radiale des nébuleuses extragalactiques*'. It contains the idea of an expanding universe and he derives what we now call Hubble's law. Lemaître's theory was based on observations of the red-shift of Vesto Slipher in 1922, and listed by Eddington. Hubble's law says that the velocity of recession is proportional to the distance. The paper even gives a value for the rate at which this happened. The so-called Hubble constant. It turned out later to be wrong by an order of magnitude, but still. So if Lemaître was the first to publish these results, then why is Hubble's name attached to it? It so happened that an (abridged) English translation of the 1927 paper was published in 1931 in the *Monthly Notices of the Royal Astronomical Society* in England. However several paragraphs were removed in the translation and in particular, the ones describing Hubble's law. So it was speculated in 2011 by some historians that someone had deliberately made this 'selective translation' to allow Hubble to claim the priority, who had basically done the same calculations, only using slightly more accurate data and meanwhile also published his results. So Livio has dug up the relevant evidence to find out who was responsible. A first piece of evidence is a handwritten letter from William Marshall Smart, editor of the *Monthly Notices* to Lemaître, asking him permission to translate and reprint his paper.

George Lemaitre

Edwin Hubble

Dear Dr. Lemaitre

At the RAS meeting last Friday, it was resolved to ask you if you would allow your paper "Un univers homogène..." in the Annals of the Soc. Sci. de Bruxelles to be reprinted in the Monthly Notices. It has been felt that it was not circulated as widely -- or isn't as well known -- as its importance warrants -- especially in English speaking countries. This request of the council is almost unique in the Society's annals and it shows you how much the Society appreciates the honour of giving your paper a greater publicity amongst English speaking scientists.

Briefly -- if the Soc. Scientifique de Bruxelles is also willing to give its permission -- we should prefer the paper translated into English. Also, if you have any further additions etc on the subject, we would gladl[y] print these too. I suppose that if these additions a note would be inserted to the effect that -en are substantially from the Brussels paper the remainder is new (or something more elegant). Personally and also on behalf of the Society I hope that you will be able to do this.

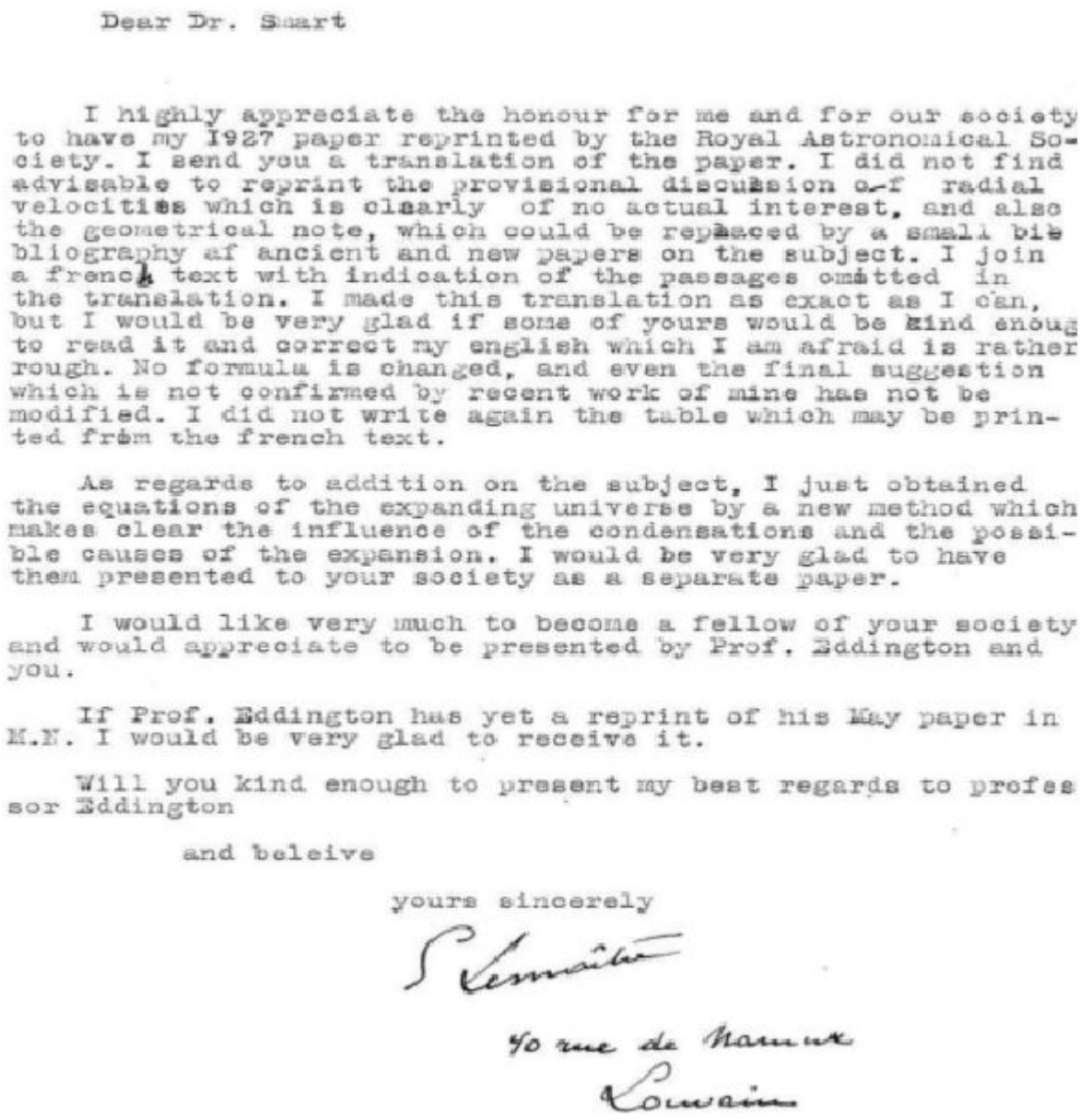
By the way, you are not a fellow of the Society: if you would like to become a fellow, would you let me know and Eddington will sign your nomination paper. In case you are ignorant of the fees etc, the annual subscription is £2-2-0 with an entrance fee of the same amount.

With kind Regards,
Sincerely yours

That letter seemed innocent. So who did the translation? Livio went to the minutes of the RAS meeting and found out that Dr. Jackson was the one who made the proposal to republish Lemaître's paper. But

[1] President of the BMS 1927-1929.

here he also found Lemaître's answer dated March 9, 1931, and that resolved the mystery.



Dear Dr. Smart

I highly appreciate the honour for me and for our society to have my 1927 paper reprinted by the Royal Astronomical Society. I send you a translation of the paper. I did not find advisable to reprint the provisional discussion of radial velocities which is clearly of no actual interest, and also the geometrical note, which could be replaced by a small bibliography of ancient and new papers on the subject. I join a french text with indication of the passages omitted in the translation. I made this translation as exact as I can, but I would be very glad if some of yours would be kind enough to read it and correct my english which I am afraid is rather rough. No formula is changed, and even the final suggestion which is not confirmed by recent work of mine has not be modified. I did not write again the table which may be printed from the french text.

As regards to addition on the subject, I just obtained the equations of the expanding universe by a new method which makes clear the influence of the condensations and the possible causes of the expansion. I would be very glad to have them presented to your society as a separate paper.

I would like very much to become a fellow of your society and would appreciate to be presented by Prof. Eddington and you.

If Prof. Eddington has yet a reprint of his May paper in M.N. I would be very glad to receive it.

Will you kind enough to present my best regards to professor Eddington

and beleive

yours sincerely

G. Lemaître

40 rue de Namur

Louvain

So this put to rest all speculations. Lemaître himself did the translation and omitted the paragraphs. Clearly he was not obsessed by a priority claim. He considered Hubble's observations more accurate and he saw no reason to repeat Hubble's results in his translation.[2] He instead wrote a new paper that was also published in the *Monthly Notices*. By the way Lemaître did accept the invitation to become a fellow of the RAS and was officially elected in 1939. When invited in 1931 to London for the conference *The Evolution of the Universe* Lemaître proposed his theory of the *Primeval Atom* for the first time[3]. Not many believed it and called it mockingly the *Big Bang* theory, a name that was so catchy that it actually contributed a lot to its popularity. At this conference cosmology and nuclear physics were connected for the first time. Lemaître was elected member of the *Royal Academy of Sciences and Arts of Belgium* in 1941. Although he did not publish it, he had a version of the Fast Fourier transform in the 1950s before Cooley and Tuckey and he introduced and programmed the first computer at the university in 1958 (a Burroughs E101). He was also the president of the Belgian Mathematical Society in the years 1947-1949.

A. Bultheel

[2] This story is found in the book but Livio published his findings first in 2011. Lost in translation: Mystery of the missing text solved, *Nature* **479**, 171-173, (2011).

[3] Later published as a letter to the editor: G. Lemaître, The Beginning of the World from the Point of View of Quantum Theory, *Nature* **127** (1931), p. 706.